NATIONAL PRESS CLUB LUNCHEON WITH NTSB CHAIRMAN CHRISTOPHER HART

SUBJECT: THE FUTURE OF AUTONOMOUS VEHICLES

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THOMAS BURR: (Sounds gavel.) Welcome to the National Press Club. My name is Thomas Burr; I'm the Washington correspondent for the *Salt Lake Tribune* and the 109th President of the National Press Club. Our guest today is National Transportation Safety Board Chairman Christopher Hart. I would like to welcome our C-SPAN and Public Radio audiences, and I want to remind you that you can follow the action on Twitter using the hashtag NPClive. That's NPClive.

Now it's time to introduce our head table guests. I'd ask that each of you stand briefly as your name is announced. Please hold your applause until I've finished introducing the entire table. From your right, Jeff Plungis, a Bloomberg News reporter who covers the automobile industry; Jonathan Salant, a Washington correspondent for the New Jersey Advanced Media and the *Star Ledger*, and a past Press Club president; Martin Di Caro, a transportation reporter at WAMU, and a contributor to Fox 5; Katie Leslie of the *Dallas Morning News*; Leann Hart, the better half of today's speaker; Kasia Klimasinska, a Bloomberg News breaking news reporter and chair of the Press Club's Speakers Committee.

Skipping over our speaker for now, Angela Greiling Keane, Bloomberg News White House correspondent, past Press Club president and the Speakers Committee member who organized this luncheon. Thank you, Angela; Sean Reilly, a reporter for Environment and Energy Publishing; Aaron Kessler, national investigative producer at Scripps News; Anthony Shop, co-founder and chief strategic officer of Social Driver, and

a member of the Press Club's Board of Governors; and David Shepparton [?], a Thomson Reuters correspondent who covers autos and technology. Thank you, all. (Applause)

National Transportation Safety Board Chairman Christopher Hart has been in this role for little over a year and already has made his mark in a job that can involve chasing the latest problems and being frustrated when it comes to preventing them. The NTSB, with a staff of 400, is an independent federal agency that investigates significant accidents involving railroads, highways, U. S. waters, pipelines and airplanes. Just this week, the board was called into action to probe a fiery, head-on crash between two freight trains in Texas.

The agency determines the probable cause of the incidents and issues safety recommendations aimed at preventing future accidents. In addition, the NTSB studies transportation safety and coordinates the resources of the federal government and other organizations to provide assistance to the victims and their families affected by major transportation disasters.

Hart is the great-nephew of James Herman Banning, who is the first African American to receive a U. S. pilot's license, which he got in 1926. Banning was killed in a crash during an air show before Hart was born, but aviation must have been passed through down the family genes. Hart is a licensed commercial pilot.

Hart's career has taken him to the Federal Aviation Administration and to an earlier term on the NTSB. He also worked for the National Highway Traffic Safety Administration, which may have sparked interest in what he's here today to talk about; autonomous vehicles. It's a wild, Wild West of a field that holds potential for improving highway safety, but also poses a lot of questions. Who is liable if a crash occurs? What happens if a technology that's supposed to help people drive more safely ends up having the opposite effect? Hart will tell us more about autonomous vehicles can benefit from lessons learned from other modes of transportation. Aviation is the most automated mode, but most other modes use some form of automation. Please help me give a warm, National Press Club welcome to National Transportation Board Chairman Christopher Hart. (Applause)

CHAIRMAN HART: Thank you, Tom, for that very kind introduction. Thanks to all of you for coming, and certainly thank you to the National Press Club for inviting me to speak on behalf of the NTSB. It's a privilege and an honor to be here. When they invited me, I warned them that they were going to have trouble shutting me up because I love talking about this stuff. But they did it anyway, and if that weren't enough, I'm an attorney so that means my credo is never use one word when two will suffice. (Laughter)

So today, I would like to speak about driverless cars. They've been called all kinds of names. I'm going to call them driverless cars. I want to talk about how the NTSB can help the process of bringing them onto our streets and highways. By doing this, I don't mean to suggest that we're looking for work because our plate is already very full, but I am suggesting that we could be a very valuable resource.

So to put my remarks in context, I'll follow up with what Tom said in terms of what the NTSB does. He described it pretty completely, but that won't stop me from using two words when one will suffice. The NTSB is an independent federal agency and we oversee accidents in all modes of transportation. Lot of people see us, think of us, as aviation accident investigators only. But we do all modes of transportation and we do that to determine what caused the accidents and then make recommendations to try to prevent them from happening again.

Our primary product is recommendations. Our world class investigators and analysts don't like to give up until they have the answer, until they found out what caused the accident. And the recommendations that they create are so compelling that the recipients respond favorably to our recommendations more than 80 percent of the time, even though they don't have to. They're not required to do that. We are not a regulator, we are a recommender, so they do that more than 80 percent of the time. And we like to think that the implementation of our recommendations has helped to make transportation safer for all of us.

Speaking personally, it's a privilege and an honor for me to be here because we do have such world class investigators and analysts, and they do all the hard work and I get all the credit, so what's not to like?

So my remarks today come from the context of our experience as accident investigators. Driverless cars are coming, there's no doubt about it. And their potential for improvement is absolutely amazing. First and foremost, driverless cars could save many, if not most, of the 32,000 lives that are lost every year on our streets and highways, 32,000; a very tragic and unacceptable number that has been decreasing for several years but has recently, as most of you know, taken a turn in the wrong direction.

Driverless cars could also increase the amount of traffic that our roads can safely carry because instead of maintaining a car length separation for every ten miles an hour, as I'm sure we all do, driverless cars could reduce that separation. Stay tuned for what other amazing changes might be possible.

And how might that happen? Ideally with automation. Most crashes on our roads are due to driver error. The theory of driverless cars is that if there's no driver, there will be no driver error. Ideally removing the driver would address at least four issues that are on the NTSB's most wanted list of transportation safety improvements; namely fatigue, distractions, impairment and fitness for duty.

The automation in driverless cars would presumably also address another item on our list, which is improved collision avoidance technologies. Decades of experience in a variety of contexts has demonstrated that automation can improve safety, reliability, productivity and efficiency. But that experience has also demonstrated that there can be a downside. As noted by Professor James Reason, who is a world renowned expert in complex human-centric systems, "In their efforts to compensate for the unreliability of

human performance, the designers of automated control systems have unwittingly created opportunities for new error types that can be even more serious than those they were seeking to avoid."

Our investigation experience provides three lessons learned that support Professor Reason's statement. The first is that the theory of removing human error by removing the human assumes that the automation is working as designed. So the question is always what if the automation quits or fails? Will it fail in a way that it is safe? If it cannot be guaranteed to fail in a way that's safe, will the operator be aware of the failure in a timely manner and will the operator then be able to take over to avoid a crash?

An example of the automation failing without the operator's knowledge occurred right here in Washington, and you may remember the metro crash near the Fort Totten station in 2009 that tragically killed the train operator and eight passengers. In that accident a train temporarily became electronically invisible. We found that there was a-- it was called a parasitic oscillation in the electronics. I minored in electrical engineering and never heard of parasitic oscillation. That's what caused this train to become electronically invisible. When that happened, the symbol of the train disappeared from the display board in the central dispatch center. When a train becomes invisible on the board, an alarm sounds. The problem is that the alarm sounded several hundred times a day, so that meant it was largely ignored.

Unfortunately when the train became electronically invisible, there was no alarm and the train behind it regarding the electronic disappearance of the preceding train. That's why the operator of the train behind was unaware of this disappearance-- of this electronic disappearance. Instead, based on the electronically unoccupied track ahead, the automation in the train behind began accelerating to the maximum speed for that area. And by the time the operator saw the stopped train and applied the emergency brake after coming around a curve, which is what limited her sight distance, it was too late.

Another lesson learned in support of Professor Reason's statement is that even if the operator's removed from the loop, humans are still involved in designing the vehicles, manufacturing the vehicles, maintaining the vehicles and they're involved in the same functions with respect to the streets and highways. Each of these points of human engagement presents yet another opportunity for human error. Moreover, human error in these steps is likely to be more systemic in its effect which means it possibly involves several vehicles instead of just one and more difficult to find and correct.

An example of this lesson learned is the collision of an automated driverless people mover into a stopped people mover at the Miami International Airport in 2008. That collision was caused largely by improper maintenance. So even though they had no operator, it still had a crash caused by some other point of intervention of human error.

The most fundamental lesson from our accident investigation experience in support of Professor Reason's statement is that introducing automation into complex human-centric systems can be very, very challenging. Most of the systems we have

investigated are becoming increasingly automated, but they are not yet fully automated. As a result, we have seen that the challenges can be even more difficult in a system that still has substantial human operator involvement and is not yet completely automated. Situations involving partial automation with substantial human operator involvement have demonstrated two extremes. On one hand, the human is the most unreliable part of the system, so that's the reason for trying to take the human out of the system.

On the other hand, if the system encounters unanticipated circumstances, a highly trained and proficient human operator can save the day by being the most adaptive part of a system. An example of a human operator saving the day is Captain Sullenberger's amazing landing in the Hudson River when his airplane suddenly became a glider because both of his engines were taken out by birds.

In stark contrast, a textbook example of the complexities of the human automation interface in which the human was the most vulnerable part of the system, is Air France Flight 447 from Rio de Janeiro to Paris in 2009. After Air France 447 reached its cruise altitude of 37,000 feet at night over the Atlantic and began approaching distant thunderstorms, the captain left the cockpit for a scheduled rest break. In doing so, he gave control to two less experienced pilots. The airplane had pitot tubes that project from the fuselage to provide information about how fast it's going.

Air speed information is so important that there were three pitot tubes for redundancy and the pitot tubes are heated in order to assure they were not disabled by ice. At the ambient temperatures of -50 to 60 degrees and with abundant super-cooled water from the nearby thunderstorms, the pitot tube heaters were overwhelmed and the pitot tubes became clogged with ice. So the airplane no longer knew how fast it was going.

The loss of air speed information caused several systems to quit, as they were designed to do when they don't have reliable information. That included the automatic pilot that was flying the airplane and the automatic throttle that was maintaining the selected speed. As a result, the pilot suddenly had to fly the airplane manually. The loss of air speed information also rendered inoperative the automatic protections that prevented the airplane from entering an aerodynamic stall in which the wings no longer produce lift. The pilots responded inappropriately to the loss of these systems and the result was a crash that tragically killed all 228 on board.

As with most accidents that we investigate, several factors played a role. To begin with, the redundancy of having three pitot tubes was not effective because all three were taken out by a common cause. In addition, the pilots had not experienced this type of failure before, even in training, where the problem can be simulated in very realistic simulators. So as a result of never having seen it before, they were unable to figure out just what went wrong.

Finally, use of the automatic pilot is mandatory at cruise altitudes so the pilots had never flown manually at that altitude before, even in training in the simulator. This is important because the airplane behaves very differently at cruise than it does at low

altitudes such as during takeoff and landing. Other operational and design issues compounded the problem and lead to the tragic outcome of the loss of 228 people.

As an aside, the pitot tubes have frozen before in that type of airplane, but the pilots in those previous encounters responded successfully. Consequently, the entire fleet, including the accident airplane, was scheduled for the installation of more robust heaters. But given that the previous encounters were successful, an immediate emergency replacement was not considered to be necessary.

With that background on how automation can be both the good news and the bad news, let me turn to how the NTSB can help inform the process of moving towards driverless cars. First, as I have just explained, we offer considerable experience regarding the introduction of automation into complex, human-centric systems. Most of our investigations involve relatively structured systems with highly trained professional operators who have various requirements regarding proficiency, fatigue, impairment, distraction and fitness for duty. Given that human drivers will probably be in the loop for some time to come, I would suggest that as difficult as that transition to more automation has been in the structured and regulated environment that we have investigated, it may be even more challenging in the public arena in which drivers are usually not highly trained and may be fatigued or impaired or distracted or not medically fit.

Query whether some whether some human drivers may always be in the loop because they would rather not use the automation for various reasons, for example. They just don't trust it or they just like to drive.

The second way that the NTSB can help relates to collaboration. The auto industry has already recognized the importance of collaboration as mostly recently shown by the collaborative approach regarding autonomous emergency braking. Our experience with collaboration, especially regarding commercial aviation, may help improve it further. So let’s talk about where we're seeing collaboration in aviation.

The most recent fatal U. S. commercial airline crash occurred in 2009, and more than once in recent years the commercial aviation industry has gone years in a row without a single passenger fatality. Although automation has played an important role in the industry's continuing safety improvement, much of the industry's exemplary safety record is attributable to collaboration. In the early 1990s after the industry accident rate had been declining rapidly, the accident rate began to flatten on a plateau. Meanwhile, the Federal Aviation Administration was predicting that the volume of flying would double in 15 to 20 years.

The industry became very concerned that if the volume doubled while the accident remained the same, the public would see twice as many airplane crashes on the news. And at that point, it doesn't help to go to the public and say, “Don't worry, the rate’s real low.” What the public counts is the number of times they see crashed airplanes on the news. So that caused the industry to do something that to my knowledge has never

been done at an industry-wide level in any other industry before or since they pursued a voluntary collaborative industry-wide approach to improving safety.

This occurred largely because David Henson, who was then the administrator of the FAA realized that the way to get off the plateau was not more regulations or bigger stick for the regulator, but instead the way was to figure out a better way to improve safety in a very complex aviation system. The voluntary collaborative process known as CAST, commercial aviation safety team, brings all the players; the airlines, the manufacturers, the pilots, the air traffic controllers, and the regulator all to the table to do four things. First, identify potential safety issues. Second, prioritize those issues because they quickly realized they'd be identifying more issues than they would have resources to fix.

Third, develop interventions for the prioritized issues. And fourth, evaluate whether the interventions were working. The CAST process has been an amazing success. It resulted in reduction of the aviation fatality rate from that plateau on which it was stuck, reduction from that plateau by more than 80 percent in less than ten years. This occurred despite the fact that the plateau was already considered to be exemplary, and many thought that the rate could not decline much further. The process also improved not only safety but productivity which flew in the face of conventional wisdom that improving safety usually decreases productivity and vice versa.

In addition, a major challenge of making improvements in complex systems is the possibility of unintended consequences. Yet, this process generated very few unintended consequences.

And last, but not least, the success occurred largely without generating any new regulations. As an observer in CAST, the NTSB can help the auto industry determine how much this aviation success story is transferable to their industry. One size may not fit all. For example, the airlines do not compete regarding safety. You've never seen an airline ad that says, “We're the safest airline out there.” But auto manufacturers do, and you always see ads by the auto manufacturers that “our car’s the safest.”

So the 80 percent reduction in the fatality rate accomplished by CAST, even though one size may not fit all, is a very powerful example of how much can be accomplished relatively quickly through voluntary collaboration.

Another difference between the two industries is that the aviation regulatory framework is largely federal whereas collaboration regarding driverless cars would probably need to include significant participation by the states.

The third way that the NTSB can inform the process of introducing automation relates to on board event recorders. Our investigations are significantly enhanced when we have event recorders to tell us what happened. Airliners have had black boxes, which of course are actually orange. They've had black boxes for decades to record both the

aircraft parameters and the sounds in the cockpit. Other transportation modes are increasingly introducing event recorders as well as audio and video recorders.

Assuming that difficulties will be encountered as automation is being introduced, the more the industry knows from the event recorders about what went right and what went wrong, the more the industry will be able to fashion remedies that effectively address the problems. Accordingly, consistent with another item on our most wanted list, expand the use of recorders to enhance transportation safety, we would encourage the use of robust on board recorders to help the process.

Event recorders and other modes of transportation introduce significant issues regarding both privacy and the appropriate use of recorder data. The NTSB's sensitivity to these issues has already helped to inform the conversation in commercial trucking and can inform the process of improving passenger vehicle event recorders as well.

In closing, rather than waiting for accidents to happen with driverless cars, the NTSB has already engaged with the industry and the regulatory agencies to help inform how driverless cars can be safely introduced into America's transportation system. Our experience in the introduction of automation into human-centric systems, our appreciation of the power of collaboration and our understanding of the importance of on-board event recorders all position the NTSB to provide valuable assistance in this process. So thank you again for inviting me to speak today. I would be happy if I have time, and I think I do, to answer any questions. Thank you, Tom. (Applause)

MR. BURR: Thank you, Mr. Chairman. We do have a lot of questions for you today, so I hope you're ready.

CHAIRMAN HART: Good. This is my favorite part.

MR. BURR: Good. Let's start off with a pretty easy question. What scares you the most about autonomous cars?

CHAIRMAN HART: That's a good question, but there isn't any single thing that scares me the most because the whole process is going to be very complicated. I think people are wildly underestimating the complexity of bringing automation into this system involving Joe Public. So there's not one thing, it's just sort of the total picture, is unnerving to me. And that's why I think we have a great opportunity to help because we can transfer that wonderful success story from other modes, mostly aviation, to help it happen better in this mode.

MR. BURR: Great. While U. S. regulators and the auto companies have huge hopes that autonomous cars will improve safety, is there a worry that the first fatal crash involving a self-driving car may bring the whole enterprise down? Isn't it likely that people will overreact to this despite the fact there are 30,000-plus highway fatalities that they're used to every year?

CHAIRMAN HART: I think it's fair to say that it will certainly-- the first fatal crash will certainly get a lot of attention. But this train has left the station. I don't think it's going to be stopped by one or even two. If there's a trend, that's another thing. But there will be fatal crashes, that's for sure. But I don't think it's going to be stopped just by a crash here and there, and especially because it's probably still happening at a lower rate than when it happens without automation.

MR. BURR: What's the best was to demonstrate autonomous vehicle technology is safe enough to be allowed on U. S. highways? Should Google cars be held to a higher standard, for example, than human-driven cars?

CHAIRMAN HART: Well, that's an interesting question. I go back to the collaboration that's going to be important. So many people are going to have to work together. The moral of collaboration is very simple. Anybody who's involved in a problem should be involved in developing the solution. And this is going to take collaboration of a lot of people to make sure that what they're doing enhances safety and generates safety as much as possible.

MR. BURR: On that note, driverless cars are likely to be on the road before states have regulatory regimes in place to govern them. What are the first steps states should take to handle regulatory complexities, especially with the mix of human drivers and driverless cars on the road?

CHAIRMAN HART: Well, I'm going to return to this topic many times, I'm sure. But it goes back to collaboration again, because it will not end up as a patchwork quilt of this state, you have to have your hand on the wheel. That state, you don't have to. There's going to have to be some uniformity across state lines and collaboration's going to help generate that. So I return to the issue of collaboration. That's going to take a lot of people working together. And this will be much more complicated than in aviation because aviation was federal, so we only had one source of legislation to look to, whereas in states it's going to be a significantly more complicated enterprise.

MR. BURR: Let me follow up on that. Already in the United States, we see a patchwork of a lot of laws governing different things. States sometimes don't work together. So do you fear the idea of driving from Utah to Colorado or something like that where there's a difference and all of a sudden you're breaking the law when you weren't in the other state because they didn't work together?

CHAIRMAN HART: That's a fair question. I think it's going to be an evolutionary process that goes back to, guess what, collaboration. I think it's going to take some time, but it will be a collaborative process where the states are realizing how much it's going to hurt their commerce if they don't join this effort collaboratively.

MR. BURR: I'm getting handed a million more questions, this is fun.

CHAIRMAN HART: You're not having as much fun as I am.

MR. BURR: I'm interested in learning more about what steps the NTSB has taken regarding this relationship between self driving cars and motorcycles. Specifically, is it safe to assume that self driving cars can detect motorcyclists? And if so, what specific precautions, or scenarios, are used to account for individual riders on motorcycles as well as groups of motorcycles?

CHAIRMAN HART: I can say as a matter of my experience in a very general way that the driverless cars are made to recognize anything out there that could be an issue. So that could be a pedestrian, it could be a deer, it could be anything that moves that is a potential problem and motorcycles will be part of that as well. So they will have to-- the driverless cars will have to figure out how to operate in the environment they are in. And that's one of the big challenges, because that environment is so variable.

MR. BURR: Do you expect some pushback from, let's say, municipal governments that count on speeding tickets for revenue? (Laughter)

CHAIRMAN HART: Good question. Next question? (Laughter)

MR. BURR: We'll put that down as a 'no comment.' What is your prediction on the rate of adoption for driverless cars?

CHAIRMAN HART: I think that people are, as I said before, underestimating the complication of making this happen, especially if you talk about when are we going to be totally driverless, except for the few people like me who just like to drive. So I think that's going to take longer than people are thinking and I think it's going to be a far more complex effort than people are thinking. So it's hard to put a time on it. I can just say that if we inform the process with the success stories from other modes like aviation, it's going to be a much smoother ride.

MR. BURR: We were chatting before the lunch. I was told by this time in my age I would have a flying skateboard at least, right? And flying cars. But how do you educate the populace about this is not necessarily science fiction, it's not going to work like it does in "Back to the Future," or other movies like that?

CHAIRMAN HART: Education is going to be a big issue. I mean, go to the basic fundamental question: does my 13 year old daughter need to even learn how to drive, or will it be driverless by the time she's driving? Probably not in her case, because that's in three years. But for someone who has a one year old, that's a real question, is do they even ever have to learn how to drive? So that's a complex question that is going to require this collaborative effort in order to address some of these big issues.

MR. BURR: Sticking on pop culture for a second, from a non-technical point of view, how do you see driverless cars changing society, culture, infrastructure?

CHAIRMAN HART: Well, I mentioned the infrastructure change because I think the ability to have cars be much closer in spacing is going to hugely increase the efficiency of the use of the infrastructure. So, I see some big differences there. I'm wondering, I mean the social scientists are looking at all kinds of ramifications of this. Like for example, do I even need to own a car or will I just call a car and say, "I need to go to work," and so a car will show up at my door and I'll take it to work. And then I call a car, "I need to go home from work and I need to go get my groceries and I need to do this and I need to do that." Well, that could be a huge change in the way our society works because will individual car ownership be necessary anymore, and will that actually increase the efficiency of us of our resources because now instead of your car being used an hour a day and parked in the garage for the rest of the time, now the use of the car is going to be much more of the day and so it'll be a far more efficient utilization of our resources.

So there's so many potential variations on that theme that I couldn't even begin to know where this exciting concept is going to go.

MR. BURR: You talked about this a little bit, but I want to pin you down if I can. Do you think autonomous vehicles should have a licensed driver in the driver's seat, or do they have potential, as you just mentioned, as kind of a carpool drivers for children, or chauffeurs for elderly people or others who can't or don't want to drive?

CHAIRMAN HART: The answer to that question, I think, varies with time. I think eventually when this whole thing is figured out, and that's going to be some task, you won't need someone who-- I mean, you can be drunk now and you can have a driverless car take you some place because you're not going to do any of the driving. So, there is already talk about the car without the brakes and without the steering wheel. So, in time, we are going to reach a point where many of the cars are that way. But that's not going to be any time soon.

Meanwhile, humans are going to have to play a significant role and that raises the challenge of if your car is mostly driving itself and then it gives up because you're in a rainy street and the rainy street now covers the lane marking so it can't see where the lane markings are, will it tell you, "You better take over because I can't find the lane markings" in time for you to effectively do that? I mean, that's one of the big challenges of automation, is how does the operator know when they need to take over and will the operator at that point be able to take over?

MR. BURR: You touched on this for a second, but is the bigger benefit of autonomous vehicles the safety on the road or the economy or changes in the savings on infrastructure, for example?

CHAIRMAN HART: Well, I can speak to the safety aspect because that's what we do is safety. And when I see the possibility of saving 32,000-plus lives a year, a number that has, as I said, now starting to go the wrong way, that is amazing. So that's what I'll speak to as the safety aspect and that's why we're so interested in this and that's

why we see an amazing opportunity for us to inform the process with what we've learned in other modes of transportation.

MR. BURR: The NTSB obviously does not get involved with the vast majority of vehicle wrecks, but if self driving cars become more common, what will the board's role be, if any, in reviewing wrecks involving automated vehicles?

CHAIRMAN HART: What we try to do in highway crashes because, as you said, there are so many more than we have staff to look at, we look at the ones that have systemic implications as opposed to just Joe had a bad day. So, I think that's probably where we'll head with driverless cars as well as we'll look at the accidents that have systemic implications that give us an opportunity to inform the process and make it better.

MR. BURR: And you raised this during your address earlier, but one of the contributing factors of the Asiana crash landing a couple of years ago in San Francisco was the pilots became too dependent on automation. How do you guard against people kind of losing the skills they might need to drive with the rise of autonomous vehicles?

CHAIRMAN HART: And that's another transitional effect that as we transition from no automation to full automation, there's that vast area in between where it's a combination of automation and driver and when that issue is going to be important. And it's just going to take some experience and hopefully learning from other modes like what we have seen to make sure that if there's a situation that the driver needs to take over, the driver-- that the alert is clear, the driver knows that it's time to take over and the driver is in a position to take over.

MR. BURR: So we're talking a lot either autonomous vehicles or self driving cars. But what about self driving trucks and I'm thinking the questioner might be referring to commercial vehicles, I assume?

CHAIRMAN HART: I've seen that already in the trade press that they are talking about self driving trucks and several, like amusement parks, have self driving buses already. So that's a reality, a very possible reality as well, is self driving-- all the vehicles on the highway are self driving. I see that as a definite possibility.

MR. BURR: And this gets to something you're probably not going to be able to answer, but we're going to try anyway. Do you have any insights on the ethics of autonomous car decision making? For example, the algorithms of making a decision to save the riders in said vehicle or other cars and pedestrians?

CHAIRMAN HART: That's going to be a major question. And we'll have to play that one by ear as the issue arises because the example that is given to me oftentimes is you got an 80,000 pound truck coming at you and so is your driverless car going to run into the 80,000 pound truck or go on the sidewalk where 25 pedestrians are? Because then it's a question of you or me. So will the driverless car have a pick me/pick them

button? I don't know. I doubt it. I'm being flip on that, but that's going to be a serious issue. Today, if a driver chose to go up on the sidewalk to avoid the 80,000 pound truck, the driver probably would not face charges for avoiding hitting the truck because that would be clearly fatal for the driver. If the software makes that decision, how is that going to happen? And there's one of the vast array of legal and ethical issues that are going to have to be addressed, again, through the collaboration and that's why this collaboration is going to have to include people who are in the law enforcement community, it's going to have to include a whole variety of people that, as I say, if they're involved in the problem, they need to be involved in the solution.

MR. BURR: On that note, as we started off in talking about this, who is responsible in a crash? Is it the driver, is it the car, is it pushing the button between choose me or choose them?

CHAIRMAN HART: Well, I am a lawyer and I'd be happy to go after the legal question, but it's not on our lane, so I'm going to pass on that.

MR. BURR: Okay. But on that note still, will driverless cars require some legislation precluding class action lawsuits in this case?

CHAIRMAN HART: I see a variety of types of legislation that are going to be necessitated by driverless cars. It's going to be a huge shift for everybody. And like I say, right now we got the difference that some states say you got to have your hands on the wheel. Other states don't, so right there is a need for some changes. There is going to be a lot of legislative action on this one at the state level, maybe the federal level as well, but definitely at the state level.

MR. BURR: The full lawyer employment act, essentially. (Laughter) Does the NTSB need any statutory authority to take a role in regulating self driving cars?

CHAIRMAN HART: I'm not able to answer that question. I don't know what their statutory authority is, what the limits are now, but it would not surprise me if there's going to be some federal legislative changes as well.

MR. BURR: As cars become more connected to the internet, do you think there should ever be a reason that drivers should be checking social media like Facebook or sending emails or texts? And if not, should the government step in to ban such activities as part of a car's infotainment system? Or should that be left to the automakers?

CHAIRMAN HART: So, that's a today question because when the car is completely driverless, that will be a moot point. But today, we have recommended that even hands free cell phone use be banned in all states. No state has done that yet, but most states ban texting because they know what a huge accident cause that is and it's just statistics say when you're texting, you are 23 times more likely, not 23 percent, 23 times more likely, to have a crash than when you're not. So almost all states prohibit texting. Many states prohibit hand-held cell phones. No state prohibit hands free cell phones. We

think that even with hands free cell phones, your mind is on your call and not on your driving task.

And so people say, well how is that any different than talking to the person next to me? Well, it's very different because the person next to you is another set of eyes who knows that you are in a construction queue or on an icy road or whatever. Whereas the person on the other end of the phone has no clue of your environment. So it is hugely different than speaking to the person next to you.

MR. BURR: Let's talk about on board event recorders for a second. What kind of data would the NTSB like to see collected? And on that same note, what about the privacy concerns of consumers with these recording devices?

CHAIRMAN HART: The privacy issues are ones that we have had to deal with big time in aviation because, as I've said, they've had the black boxes in airplanes for decades. And so far, we have not had any breach of information that created a privacy concern. So we've shown, we meaning the industry, has shown an ability to use that information carefully. We use it only for one purpose, and that is to figure out what caused the accident so that we can try to keep that from happening again.

What the owner of the box does, and in this case the owner would be the airline, that's up to them. But the law doesn't allow us to do anything with that except use it to improve safety.

MR. BURR: Sorry, I'm just laughing about one of the questions I got. We'll ask that one later. You've referred to collaboration several times. What kind of collaboration is already happening and what's happening, what's needed to happen?

CHAIRMAN HART: The example that I used for collaboration was regarding the autonomous emergency braking and the agreement to institute it voluntarily. And we applaud that because we know from huge experience in aviation that this 80 percent reduction in the fatal accident rate was primarily a result of that amazing collaboration was primarily a result of that amazing collaboration. We know how powerful voluntary collaboration can be, and I think this agreement, which reaches over 90 percent of the cars that are being made, that is huge to be able to have it happen as quickly as it did. It would never have happened that quickly if it had awaited a regulatory result.

MR. BURR: Moving on to a little different subject, what is the best way that you see to reduce U. S. vehicle crashes?

CHAIRMAN HART: Automation. (Laughter) No, for about 20-- just to be more specific, for about 20 years, we've been pushing for something that is a collision avoidance system. That, A, a warning, and B a way to stop the collision from occurring. We've had recommendations on that subject or subjects like it for more than 20 years. So that's certainly step number one, is collision avoidance technology that prevents cars from hitting each other. So that's one of the foundation stones for moving to driverless cars.

MR. BURR: Let's talk about trains for a second. Despite several high profile fiery crashes involving oil trains, such trains continue to run through the heart of certain American cities such as Philadelphia or here in Washington near the United States capitol. Should trains carrying crude oil be banned from traveling through densely populated down areas in the United States?

CHAIRMAN HART: After the discovery of oil in North Dakota, we all of a sudden saw a lot more crude oil train derailments. And historically before that, if a train derailed, it might be a mile long train with five or seven or ten cars of crude oil. Now it's a mile long train of nothing but crude oil. So if that train derails and one car breaches, it only takes one car and puts product out in the environment and something ignites that product, then the other cars, even if they didn't breach by puncture, are in a thermal environment that encourages breaching.

So we know that step number one is to keep the trains on the track and we've pushed hard for that. Step number two is to have more robust tank cars. And step number three is to address the emergency response community, because a lot of these accidents happen in the middle of nowhere where it's just a volunteer fire department who hasn't ever seen a hazardous material spill more than a little diesel fuel on the highway.

So it's a three-legged stool that we have to go after. And we started pushing that big time because of the amazing increase in not only carriage of crude oil, which happened because of the North Dakota find, but then also we have an amazing increase in ethanol which came because of the law that says we want to reduce our dependence eon foreign oil so we're going to start putting ethanol in the gasoline. So now we have trains from the corn states to the states that make the oil.

And so those two things causes a huge rise in trains carrying hazardous material. And the cars they were carrying them in were the same cars that were used to carry corn oil. So that was completely unacceptable. So now, there's is a transition towards much more robust train cars. But the first step is to keep the train on the track. So that talks about track maintenance, it talk about wheel and axle maintenance, it talks about doing everything you can, positive train control, to keep the train on the track.

MR. BURR: Speaking of positive train control, there was another trash crash this week that may have been prevented by positive train control. Are you frustrated that railroads have gotten Congress to extend the deadline for them to have PTC, positive train control, in the places where passenger rail safety requires them to?

CHAIRMAN HART: Well, we've been pushing positive train control in one form or another since the late '60s. So it's not new to us. When we first started our most wanted list in 1990, it was on that list and has been on it almost continuously ever since. We took it off briefly when Congress enacted a law that says, "You must do this by the end of 2015." And we said, "Okay, we've taken care of that problem." But guess what? They hadn't because nobody finished it by-- very few people finished it by 2015.

So yes, it is an ongoing challenge for us. We don't call it frustration, we call it a challenge. And that's what keeps us going, is we know we have the opportunity to move the needle.

MR. BURR: Here in Washington, as we all know, the metro has a few issues. But for a while--

CHAIRMAN HART: I rode here myself today.

MR. BURR: You were early, though. (Laughter)

CHAIRMAN HART: Go figure.

MR. BURR: But metro has been using manual operations for a while. What is the NTSB's position on using automated operations on public rail transit systems?

CHAIRMAN HART: Well, we're starting to seer that. The first place where we saw it big time was in airport trains. So most airports that you go to now, the trains are typically operatorless. I'm old enough to remember when elevators had operators. So, that shows how far back I go. But what we look at is what's the safest way to do it? If it's automation, then we're in favor of it. If it's not automation, then we're in favor of it. [00:42:08] was having problem with their automation and to their credit, they stopped using it when it wasn't working properly.

Of course, when you go manual that means you're going to have a more jerky ride because the starts are more jerky, the stops are more jerky. Because I can compare it with the automated trains that I've ridden on in Paris and Singapore and they're just really, really smooth just like elevators are typically. They start and stop smoothly. So, our concern at the NTSB is safety. So what's the safest way to do it? And to their credit when they realized it wasn't doing as it was supposed to, then time to go back to manual.

MR. BURR: Staying on metro for a second, how would you appraise the performance of the FTA thus far in WMTA, MTA's safe tracking program?

CHAIRMAN HART: We have a recommendation after the smoke event in L'Enfant Plaza station in January 2015. We put out a recommendation that we don't think the Federal Transit Administration is well suited to oversee this transit property. And the reason is because for most of Federal Transmit Administration's existence, they had no safety authority whatsoever. They were basically a funding agency. They gave out grants to build infrastructure.

So, for most of that time, they had no safety authority. After the 2009 Fort Totten accident, we said this agency needs safety authority because the transit properties in the U. S. have no federal safety oversight. So we recommended that FTA seek that safety authority, and they did. So, since most states already had state regulatory mechanisms

like New York and Illinois and Pennsylvania and California and Texas and Florida, they already had state level. So when they created the FTA's safety authority they said, "Let's not dismantle this whole state system because it's working pretty well. Let's let the FTA work through the states."

So that's easy when there's only one state involved. In a few situations, there are two states involved. but in those situations, there's a handful of them, they've reached agreement, I'll take the back seat, you take the front seat. Our jurisdiction has three; Maryland, D.C. and Virginia. And those are three difficult cats to hurt. So getting them to work together and getting the FTA to work through those three states hasn't worked so far. And we're trying to look for an immediate solution and our view on the immediate solution is to let the Federal Railroad Administration do it because they don't work through the states and they can do it more directly than the Federal Transit Administration who has to wait for the three jurisdictions to enact legislation and have an agreement to say that they can work together. And that might happen by the time my 13 year old daughter graduates from high school.

So we want more immediate action, and we think the way to get that, and our recommendation says it, that the Federal Railroad Administration oversee this property because this property has to report to three jurisdictions, and that is simply we're the only one in the country that way, with three, and that is simply not working.

MR. BURR: The NTSB under your predecessor Debbie Hersman, gave a lot of attention to drugs driving as distinct from drunken driving. Now that marijuana is legal in many states, does there need to be a legal national limit like there is for alcohol to decide who's too impaired to drive after ingesting marijuana?

CHAIRMAN HART: We are very concerned because in every mode of transportation, we have seen a troubling uptick in the use of drugs. My state, Colorado, is one of them that legalized marijuana so we are very concerned that that's going to cause us to see more use of drugs in transportation accidents.

I'll give you one very troubling example, and that was a truck accident where an 80,000 pound truck crossed over the median on the interstate, hit an oncoming bus and killed several people on the bus. Truck driver was also killed. We found paraphernalia in the truck and that was the only way we knew that this truck driver was using a synthetic drug, because we traced it from the paraphernalia.

Well, guess what? This synthetic drug is one that's available legally over the counter at a truck stop. That's very troubling, that something that is an impairing drug is obtainable legally on the highway at a truck stop. So we're very challenged with drugs because there's all these synthetic drugs. We don't have a good understanding of how they work, we don't know the metabolistic history of them in the body so that when we come after-- because we can now look at alcohol and marijuana and we can tell from a backward look, we can reverse engineer what was the state at the time of the accident. Most of the drugs, we don't have that knowledge, we don't know how the drugs interact

with each other, we don't know how they interact with alcohol, how they interact with fatigue. There are lots of issues regarding drugs that are very troubling and that we're concerned and we're seeing a troubling uptick in every mode of transportation.

MR. BURR: What do you see in general as the board's greatest weaknesses and needs, and how do you think that'll be impacted by either Secretary Clinton or Donald Trump in the White House?

CHAIRMAN HART: Our challenge is always trying to figure out what's the best next direction to go. So when all of a sudden a lot of oil trains are coming out of North Dakota, we're seeing all of a sudden a lot of derailments. And our rail staff was not prepared for that sudden spike in their workload. So our challenge is always trying to be strategic and figure out what's the next thing we need to do so that we're ready to handle that variability when it arises.

MR. BURR: In your time, since this is a regulatory agency, which recommendation agency-- which mode of transportation has been most receptive to following your recommendations?

CHAIRMAN HART: That's a good question. The number that I mentioned, that more than 80 percent of the time our recommendations are responded to favorably, I'm afraid I don't have a breakdown on how that goes from mode to mode. It's probably fairly universal across the modes, but I'd have to get back to you with a more detailed breakdown on that.

MR. BURR: Let’s talk about those who don't, though. Why do you think some federal agencies and Congress have not been receptive following some recommendations?

CHAIRMAN HART: Well, Congress created us to be-- one of the things that they put in our enabling legislation is we look only at safety. We do not do cost benefit studies. So the regulators, they have to look at the total picture and not just the safety picture. So they have to look at the totality of circumstances that affect what they do. We're supposed to be the ones that provide the answer in an ideal safety world if safety were your only consideration. And, of course, it never is. So right there, there's a tension between us and the regulators.

So I give kudos to Congress for creating us that way because what that means is that if the regulators in the industry were doing 100 percent of what we recommended, that means something is probably broke. That means we're not being safety only enough, or that means the regulator is being safety only too much. On the other hand, if 60 percent of our recommendations are being responded to favorably, probably something is broke there, too. I think the safety experts would agree that around 80-ish percent is about right to show that the tension that Congress intentionally created between us and the industry is working.

So, yes we have to have our hand on the pulse of the economic reality. So for example, when we first recommended ground proximity warning systems on airplanes, that's a system that warns the pilot, "You are approaching the ground too fast under the circumstances. You better do something about it." So when we first started that recommendation, these were big, bulky expensive things that okay, you can put them on a 747 but you're not going to put them on a 19-seat Beech 1900 because it's too big and expensive and bulky to put on the little airplane.

So when we first made that recommendation, we limited it to the big airplanes. Then, as the technology improved and they got smaller and cheaper and better, then we started recommending them on all airplanes. So, no third decimal point cost benefit study, but we did have to have our finger on the pulse of economic reality.

MR. BURR: So let's talk about this for just a second, then. Do you think the NTSB should be given more than advisory power?

CHAIRMAN HART: That's a good question, and people ask me that a lot. They say why not mandate what the NTSB does? I think the reason that our product is so good is precisely because it's not mandatory. I think that means our staff knows that if this isn't a real good idea, people are going to ignore it because they can. Well, people don't ignore it more than 80 percent of the time. And that's, to me, if it was mandatory, then there's something wrong with telling us we have to be safety only. Because if we're safety only and it's mandatory, that's a disconnect. So I think it's a good idea that we aren't mandatory, and I think that's one of the reasons our product is as world class as it is, because our staff knows that if it's not a really good idea, people just won't do it.

MR. BURR: I think you told me your term is up in March, but you've been at the NTSB for a while. Now that Obama's presidency is almost done, how would you assess his administration's record on transportation safety?

CHAIRMAN HART: In general, all of the industries are improving in their safety and that's the real good news. One of the problems that we've seen that's a generic problem across all the modes is that most-- that regulations have to go through the Office of Management and Budget. And the Office of Management and Budget has a cost benefit test. So as all the industries get safer, we know that that filter is getting ever-more challenging.

So when we send a recommendation that says require, that's NTSB speak for promulgate a new regulation. And then many times we're told, "Well, but we're so safe that OMB says where are the dead bodies, and there may not be any, or enough." And then that stops the regulation. So, in a bigger picture sense, I think we need to have a conversation about yes, there needs to be some kind of a cost benefit filter because we don't want money just spent willy-nilly without having a clear benefit to it. But I think we need to have a conversation about how to update that cost benefit test to make it more realistic.

So for example, the cost benefit test caused a split in the fatigue requirements in big airplanes. So if you're flying a big passenger airplane, you have different fatigues requirements than if you're flying a big cargo airplane. Our view on that is a big cargo airplane is in the air space and if it collides with another big airplane, it's going to be just as bad if it's carrying cargo as if it were carrying passengers. But the cost benefit test said, well, how many cargo airplanes have we seen that crashed due to fatigue, as opposed to how many big airplanes have we seen?

I think it's a different way to ask the question and I think the process can improve by being updated with the new realities.

MR. BURR: Since you're here at the National Press Club, I thought I'd ask you, any advice to reporters covering accidents being investigated by the NTSB?

CHAIRMAN HART: Well, most of the industries we deal with have a huge problem with the media because of the strong emphasis on sensationalism. So just to give you an example, it's somewhat dated now, but I'm not sure if it's unrealistic anymore. So when airplane crashed, American Airlines crashed in Cali, Colombia in 1996 and it was a very difficult environment. Took a long time for people to get there. So when they got there, the bodies had been there for some time, okay? So, when they got there they said--they found alcohol in the pilot's blood.

Well, and so that was big front news, big front page news, alcohol in the pilot's blood. Then four days later, on page B6 was, "Oh, this alcohol was putrification alcohol, not consumption alcohol." But meanwhile, the pilot's reputation has been sullied, the airline's reputation's been sullied because now the public is thinking, "Oh, this pilot was drunk." Well, so the accuracy of the coverage is crucial and we used to be in control of the information a lot more than we are. We're not so much in control of it anymore.

For example, in the one that you mentioned in San Francisco, the Asiana crash, that crash was actually on YouTube from the guy who filmed it across the bay before we were even formally notified that there had been an accident. So much for being in control of the information.

And then to add to that complication, so there was that video and then the recorders were in good shape so we quickly got the information out of the recorders and we found that, from the recorder, that the pilot was low and slow, which was also verified by the video. Well, so we went on in our--because we're very transparent with the facts. So we went on and said, "We have found from the cockpit voice recorders, and verified, that the airplane was low and slow." Well, meanwhile the airline is on the media saying, two days after the crash, the airplane was fine. And so we're saying how would they know that two days after the crash? We don't have a clue if the airplane was fine or not. But they said the airplane was fine. We said the airplane was low and slow. And now the public concludes, oh, two plus two, pilot error.

So then Airline Pilots Association gets mad at us for saying it was pilot error. We didn't say it was pilot error, we said low and slow. We've seen low and slow when it wasn't pilot error, but yet the airline said the airplane was okay so people put that together. We had no control over what the airline said. So information flow is going to be a challenge and it's crucial. Everybody's trying to be first, but accuracy is far better than primacy. So, that's one of our big challenges, is that everybody's trying to be first and sensationalism seems to carry the day much more than we would like it to happen.

MR. BURR: So caution is the thing you're telling reporters?

CHAIRMAN HART: Correct.

MR. BURR: Okay. You said 80 percent of recommendations are taken but 20 percent aren't, then. Is it frustrating to have to make the same recommendations over and over again?

CHAIRMAN HART: Well, as I say, we don't call that frustrating, we call that a challenge because that's what we're here for, is to generate challenges. For example, after TWA 800, the one that took off from Kennedy and exploded over Long Island Sound. And as a result of that, we recommended inerting the fuel tank because that was a fuel tank explosion where the fuel tank was mostly empty, just had a little bit of fuel in it. But it was very, very hot because this airplane had been sitting on the ramp at Kennedy for two hours while they were trying to do a bag match thing and check on-- make sure that all the passengers were on whose bags were on.

Meanwhile, there's the air conditioning that's blasting that's right under the center fuel tank, which is mostly air now and a little bit of fuel. And that air conditioner, of course, puts out heat. It cools the cabin, but it generates heat, as you know from your air conditioner. So it's heating up this tank and now you've got the oxygen from the atmosphere, you've got the fuel from the fuel and someplace a spark came from it. But that tank was dangerously close to a flash point where it would have gone without any spark, just sua sponte, and it was dangerously close to that from sitting on the ramp in a July day at Kennedy with this air conditioning going on under it vigorously.

And, of course, then you ask Boeing, "Why'd you put the air conditioner right under the fuel tank?" And they said, "Well, that's simple because we want to heat that fuel up because when it's -50 degrees at altitude, we don't want to send -50 degree fuel to the engine because it's very inefficient so we want to warm it up first. So that's why the air conditioner was placed.

So the point is we recommended inerting the fuel tank so that the empty space is not atmosphere with its 20 percent oxygen. And we recommended inerting it. And back then they said, "Impossible." Well, we knew it wasn't impossible because the military had been inerting fuel tanks for a long time. So we pushed for inerting. Well, first that started the conversation, then it started the research and today they're doing it. So, we

push and we push and we push and when we think it can be done, we're going to keep on going until it is done.

MR. BURR: Let's switch back to driverless cars for a second. Are you concerned that the NTSB might be left out of the race for recommendations with driverless cars?

CHAIRMAN HART: I think the biggest advantage of using us at this point is taking advantage of our knowledge of other modes, which is what I talked about today. I'm not concerned about us being left out, we're already in the conversation. But I think if people don't take advantage of that experience with other modes, then they're missing a valuable opportunity to avoid the bumps in the road, excusing the pun, that we have seen in other modes and that we can avoid in this mode.

MR. BURR: There's a big difference between somebody who's flying an airplane and driving a train. Those are jobs versus consumers who are going to work and driving on occasion. That's probably more of an education process than a manufacturer can take on. I assume that's going to take more of a public campaign from the government as well?

CHAIRMAN HART: Yes, and that's why I say it's much-- I think it's going to be much more challenging to introduce automation into a public arena than in the situations we've seen where it's introduced into a very structured situation with requirements for-- proficiency requirements for fatigue, requirements for distraction, requirements for lots of things that these professionals, who by the way are there because they are highly trained and proud of doing the right thing. That's going to be a very different environment than doing it with Joe Public.

MR. BURR: Thank you, Mr. Chairman. Before I ask the last question, I have a few announcements. A quick reminder, the National Press Club is the world's leading professional organization for journalists and we fight for a free press worldwide. For more information about the club, please visit www.pressorg. Once again, that's press.org.

I'd also like to remind you about a couple of upcoming programs. One week from today, July 7, Libertarian presidential candidate Gary Johnson and his running mate William Weld will be here. On July 14, Admiral Mike Rogers, the Director of the National Security Agency, will speak at a Press Club luncheon. And on August 1st, Jonathan Jarvis, the Director of the National Park Service, will address the club. Now I'd like to present our guest with the traditional National Press Club mug. (Applause)

CHAIRMAN HART: Thank you.

MR. BURR: And this is why I was chuckling earlier. Mr. Chairman, have you seen "Terminator II?" And aren't you afraid that if some level cars could become smarter than us?

CHAIRMAN HART: No, I have not seen "Terminator II" and it's very likely that cars will become smarter than us, but I'm not afraid of it. I think it'll be a good thing.

MR. BURR: Thank you, Mr. Chairman. I'd like to thank the staff of the National Press Club as well as the staff of the National Press Club Journalism Institute. Thank you very much for being here, we are adjourned. (Applause) (Sounds gavel.)

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